

home

searching ▾

patents ▾

documents ▾

toc journal watch ▾

**Format Examples****US Patent**

US6024053 or 6024053

**US Design Patent**

D0318249

**US Plant Patents**

PP8901

**US Reissue**

RE35312

**US SIR**

H1523

**US Patent Applications**

20020012233

**World Patents**

WO04001234 or WO2004012345

**European**

EP1067252

**Great Britain**

GB2018332

**German**

DE29980239

**Nerac Document Number (NDN)**

certain NDN numbers can be used for patents

[view examples](#)6.0 recommended  
Win98SE/2000/XP**Patent Ordering** help**Enter Patent Type and Number:** optional reference note**GO**
☐ Add patent to cart automatically. If you uncheck this box then you must *click on* Publication number and view abstract to Add to Cart.

51 Patent(s) in Cart


**Patent Abstract** Add to cart**EPA 2003-01-22 1026031/EP-A3 Dual-band infra-red vision system for motor-vehicles****INVENTOR-** Perlo, Piero Via Chichignolo 19 12048 Sommariva Bosco (Cuneo) IT**INVENTOR-** Repetto, Piermario Via Sismonda 10/6 10145 Torino IT**INVENTOR-** Bigliati, Claudia Via Gramsci 15 13039 Trino (Vercelli) IT**INVENTOR-** Lambertini, Vito Via Monsignor Re, 10 10049 Giaveno (Torino) IT**INVENTOR-** Sinesi, Sabino Via Pietro Micca 14 10045 Piossasco IT**PATENT ASSIGNEE-** C.R.F. Societa Consortile per Azioni Strada Torino, 50 10043 Orbassano (Torino) IT**DESIGNATED COUNTRIES-** AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE**PATENT APPLICATION NUMBER-** 00830062.6**DATE FILED-** 2000-01-28**PUBLICATION NUMBER-** 01026031/EP-A3**PUBLICATION DATE-** 2000-08-09**PATENT PRIORITY INFORMATION-** TO990073, 1999-02-02, IT**FIRM-** Notaro, Giancarlo et al, c/o Buzzi, Notaro & Antonielli d'Oulx Via Maria Vittoria 18, 10123 Torino, IT**INTERNATIONAL PATENT CLASS-** B60Q00120; B62D01502; B60Q00100**PUBLICATION-** 2000-08-09, A3, Separate publication of search report; 2003-01-22**FILING LANGUAGE-** ITA

**PROCEDURE LANGUAGE- ENG****DESIGNATED COUNTRY-** AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE**LANGUAGE-** ENG    **NDN-** 113-0117-7001-4

An infrared vision system for motor vehicles comprises a device (8) for detecting infrared radiation, which is designed to detect both infrared radiation in a first wave band, which corresponds to the radiation spontaneously emitted by the objects making up the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted spontaneously by the objects of the scene and in part is emitted by a source (5) of infrared radiation which forms part of the vision system (1) and is reflected by the objects in front of the vehicle towards the said detecting device (8).

**EXEMPLARY CLAIMS-** An infrared vision system for motor vehicles, comprising an infrared-radiation detecting device (8) designed to be mounted on the front of a motor vehicle, the device including infrared sensor means (9) designed to emit electrical signals according to the infrared radiation detected, optical imaging means (8) for focusing the infrared image of the scene in front of the vehicle on said sensor means (9), electronic means (10) for processing the signals issued by the sensor means (9), and image-displaying means (15) controlled by said electronic means (10), characterized in that said optical imaging means (8) are designed to focus both infrared radiation in a first wave band, corresponding to the radiation spontaneously emitted by the objects of the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted spontaneously by the objects of the scene, and in part is emitted by a source (5) of infrared radiation which forms part of said vision system (1) and is reflected by the objects in front of the vehicle towards said detecting device (8).

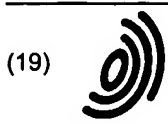
NO-DESCRIPTORS

 proceed to checkout

Nerac, Inc. One Technology Drive . Tolland, CT  
Phone (860) 872-7000 Fax (860) 875-1749

©1995-2003 All Rights Reserved . [Privacy Statement](#) . [Report a Problem](#)





Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 1 026 031 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
09.08.2000 Bulletin 2000/32

(51) Int. Cl.<sup>7</sup>: **B60Q 1/14, B60Q 1/20**

(21) Application number: **00830062.6**

(22) Date of filing: **28.01.2000**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

(30) Priority: **02.02.1999 IT TO990073**

(71) Applicant:  
**C.R.F. Societa' Consortile per Azioni  
10043 Orbassano (Torino) (IT)**

(72) Inventors:  
• **Perlo, Piero  
12048 Sommariva Bosco (Cuneo) (IT)**

• **Repetto, Piermario  
10145 Torino (IT)**  
• **Bigliati, Claudia  
13039 Trino (Vercelli) (IT)**  
• **Lambertini, Vito  
10049 Giaveno (Torino) (IT)**  
• **Sinesi, Sabino  
10045 Piossasco (IT)**

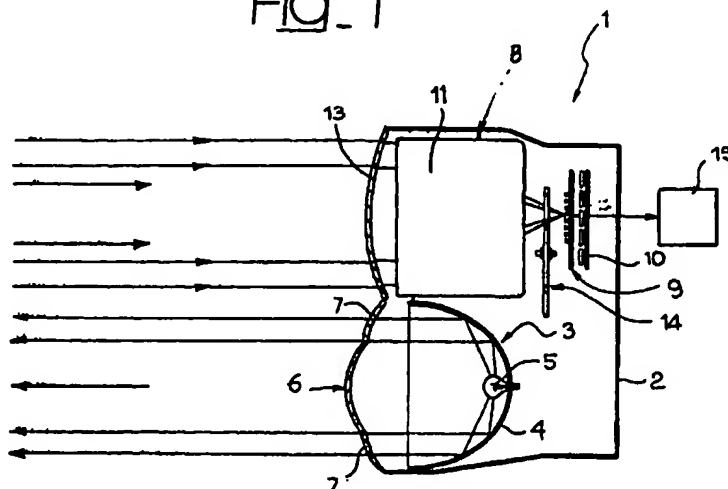
(74) Representative:  
**Notaro, Giancarlo et al  
c/o Buzzi, Notaro & Antonielli d'Oulx srl,  
Corso Fiume 6  
10133 Torino (IT)**

(54) **Dual-band infra-red vision system for motor-vehicles**

(57) An infrared vision system for motor vehicles comprises a device (8) for detecting infrared radiation, which is designed to detect both infrared radiation in a first wave band, which corresponds to the radiation spontaneously emitted by the objects making up the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted

spontaneously by the objects of the scene and in part is emitted by a source (5) of infrared radiation which forms part of the vision system (1) and is reflected by the objects in front of the vehicle towards the said detecting device (8).

Fig. 1



EP 1 026 031 A2

## Description

**[0001]** The present invention relates to infrared vision systems for motor vehicles, of the type comprising an infrared-radiation detecting device designed to be mounted on the front of a motor vehicle, the device including infrared sensor means designed to emit electrical signals according to the infrared radiation detected, optical imaging means for focusing the infrared image of the scene in front of the vehicle on said sensor means, electronic means for processing the signals issued by the sensor means, and image-displaying means controlled by said electronic means.

**[0002]** The known infrared vision systems that have so far been produced exploit infrared radiation in a wave band ranging from 8 to 14 micron (longwave window - LW), which is emitted spontaneously to a variable extent by all the objects of the scene in front of the motor vehicle. These systems do not enable optimal results to be achieved, especially in particular conditions, such as in the presence of fog.

**[0003]** The purpose of the present invention is to propose a new infrared vision system for motor vehicles that enables improvement of night vision in all conditions, and in particular in the presence of thick fog.

**[0004]** In order to achieve the above purpose, the subject of the invention is a vision system of the type specified above, characterized in that the aforesaid optical imaging means are designed to focus both infrared radiation in a first wave band, corresponding to the radiation spontaneously emitted by the objects of the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted spontaneously by the objects of the scene, and in part is emitted by a source of infrared radiation which forms part of the vision system and is reflected by the objects in front of the vehicle towards said detecting device.

**[0005]** As has already been mentioned, the radiation emitted spontaneously by the scene falls within a wavelength range of between 8 and 14 micron (longwave window - LW). In a preferred embodiment of the invention, the above-mentioned infrared-radiation source forming part of the system is designed to emit radiation in a wave band of between 3 and 5 micron (midwave window - MW). This radiation is reflected by the objects of the scene, and is then detected by the sensor means forming part of the system according to the invention. Again according to the invention, the aforesaid optical imaging means comprise two optical imaging devices, which are combined in such a way as to minimize dispersion between the two aforesaid wave bands, and a discriminator designed to send to the sensor means alternately the radiation in the first band and the radiation in the second band (for example, a discriminator of a rotary type).

**[0006]** In a preferred embodiment, the above-mentioned sensor means consist of a matrix of non-cooled thermal sensors, of a type chosen from among pyro-

electric sensors, resistive bolometers, ferro-electric bolometers, and thermo-electric sensors of a conventional type.

**[0007]** Again in the case of the preferred embodiment, the said infrared-radiation source consists of a headlight of the motor vehicle which has a front element that is at least in part transparent to infrared radiation. In this case, the detecting device of the vision system according to the invention is built into the said headlight of the motor vehicle.

**[0008]** The control electronics forming part of the system according to the invention makes it possible to read, interpret and superimpose the infrared images in the two bands acquired by the sensors, so presenting a single infrared image of the scene on the display means at output. The main advantage of the system according to the invention is that it enables simultaneous exploitation of the greater intensity of the IR image in the 8-14 micron LW window and the greater contrast of the IR image in the 3-4 micron MW window in the temperature range of interest.

**[0009]** Further characteristics and advantages of the invention will emerge from the ensuing description with reference to the attached drawings, which are provided purely as a non-limiting example and in which:

Figure 1 is a cross-sectional schematic view of a vision system according to the invention;

Figure 2 is a front view of a rotary discriminator forming part of the system of Figure 1; and

Figure 3 illustrates a variant of Figure 2.

**[0010]** In Figure 1, the reference number 1 designates, as a whole, a motor-vehicle headlight comprising a rigid casing 2 inside which is set a headlight 3 including a parabolic dish 4 associated to a lamp 5. The reference number 6 designates the transparent front element of the headlight 3, which presents, in the case of the example illustrated, peripheral windows 7 that are transparent to infrared radiation. The lamp 5 is chosen so as to emit infrared radiation in a wave band of between 3 and 5 micron.

**[0011]** The body 2 of the headlight 1 also includes an infrared-radiation detecting device 8 comprising infrared sensor means 9 consisting of a matrix of non-cooled thermal sensors, for example pyro-electric sensors or resistive bolometers, or ferro-electric bolometers, or thermoelectric sensors of a conventional type, which are designed to send electrical signals according to the infrared image detected to a processing electronic control unit 10. The detecting device 8 comprises an optical imaging system 11 which is designed to focus on the sensors 9 both the infrared image in the 3-5 micron wave band, which is reflected by the objects of the scene in front of the vehicle, and the infrared radiation in the 8-14 micron wave band, which is emitted spontaneously by the objects of the scene. The detecting device 8 has, at the front, a window 13 which is

transparent to infrared radiation.

**[0012]** Between the optical imaging system 11 and the matrix of sensors 9 is set a rotary optical discriminator 14, of which Figure 2 and 3 illustrate two possible embodiments. In both cases, the said optical discriminator 14 consists of a disc having sectors A that are transparent to infrared radiation of between 8 and 14 micron, sectors B that are transparent to infrared radiation of between 3 and 5 micron, and opaque sectors C that clearly divide the sectors A from the sectors B. The rotary discriminator 14 is used to send alternately the 8-14 micron infrared radiation and the 3-5 micron infrared radiation to the sensor means 9. The electronic control unit 10 is designed to read, interpret and superimpose the infrared images in the two bands acquired by the sensors, presenting at output, on a display 15 provided on the motor vehicle dashboard or on the windscreen itself, according to a HEAD-UP type technology, a single infrared image of the scene. As has already been mentioned, the main advantage of the device lies in the fact that it enables simultaneous exploitation of the greater intensity of the IR image in the 8-14 micron band and the greater contrast of the IR image in the 3-5 micron band.

**[0013]** The source of 3-5 micron IR radiation could also be a dedicated source, distinct from the vehicle headlight.

**[0014]** Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to what is herein described and illustrated purely for the purpose of providing an example, without thereby departing from the scope of the present invention.

#### Claims

1. An infrared vision system for motor vehicles, comprising an infrared-radiation detecting device (8) designed to be mounted on the front of a motor vehicle, the device including infrared sensor means (9) designed to emit electrical signals according to the infrared radiation detected, optical imaging means (8) for focusing the infrared image of the scene in front of the vehicle on said sensor means (9), electronic means (10) for processing the signals issued by the sensor means (9), and image-displaying means (15) controlled by said electronic means (10), characterized in that said optical imaging means (8) are designed to focus both infrared radiation in a first wave band, corresponding to the radiation spontaneously emitted by the objects of the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted spontaneously by the objects of the scene, and in part is emitted by a source (5) of infrared radiation which forms part of said vision system (1) and is reflected by the objects in front of the vehicle

towards said detecting device (8).

2. A vision system according to Claim 1, characterized in that the optical imaging means (8) comprise two optical imaging devices (11, 12), which are combined in such a way as to minimize dispersion between the two aforesaid wave bands, and a rotary discriminator (14) designed to send to the sensor means (9) alternately the radiation in the first band and the radiation in the second band.
3. A vision system according to Claim 2, characterized in that the sensor means (9) consist of a matrix of non-cooled thermal sensors, of a type chosen from among pyro-electric sensors, resistive bolometers, ferro-electric bolometers, and thermo-electric sensors of a conventional type.
4. A vision system according to Claim 1, characterized in that said first band includes wavelengths ranging from 8 to 14 micron.
5. A vision system according to Claim 1, characterized in that said second band includes wavelengths ranging from 3 to 5 micron.
6. A vision system according to Claim 1, characterized in that said infrared-radiation source (5) consists of a headlight (3) of the motor vehicle, which has a front element (6), at least part (7) of which is transparent to said infrared radiation.
7. A vision system according to Claim 1, characterized in that the control electronics forming part of the system according to the invention makes it possible to read, interpret and superimpose the infrared images in the two bands acquired by the sensors, so presenting a single infrared image of the scene on the display means at output.

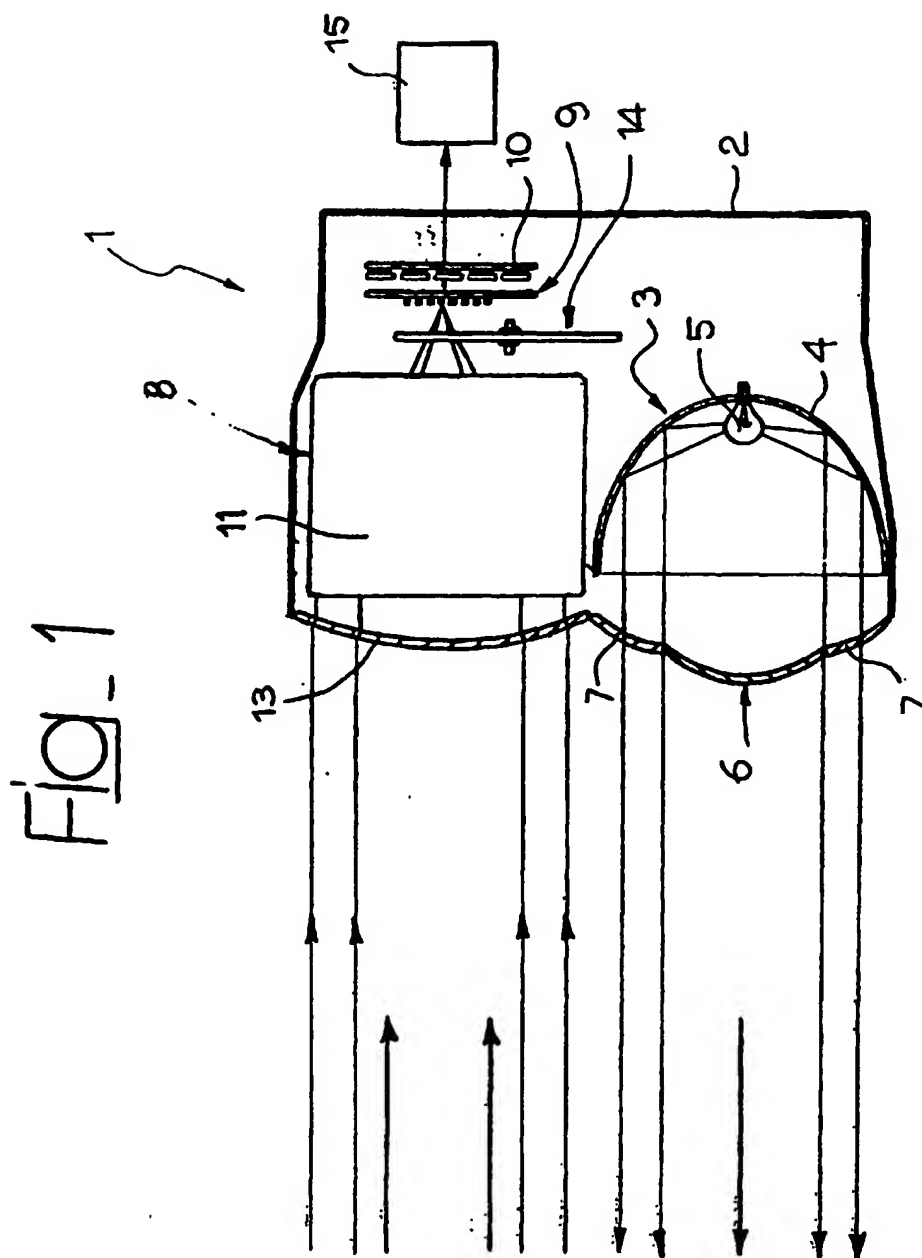


Fig. 2

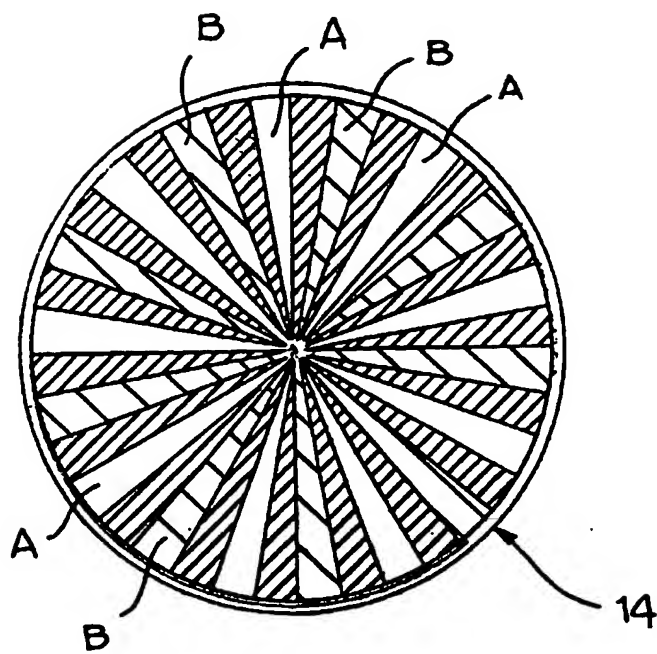
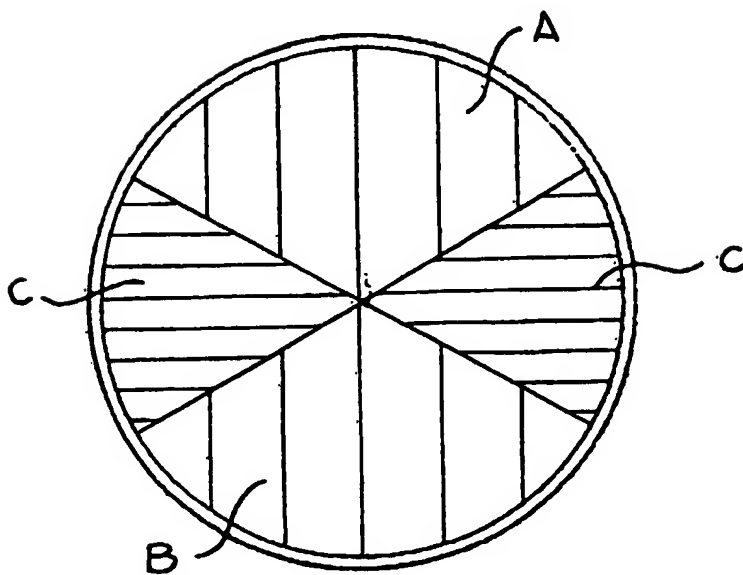


Fig. 3







(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
**22.01.2003 Bulletin 2003/04**

(51) Int Cl.7: **B60Q 1/20, B62D 15/02,**  
**B60Q 1/00**

(43) Date of publication A2:  
**09.08.2000 Bulletin 2000/32**

(21) Application number: **00830062.6**

(22) Date of filing: **28.01.2000**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU**  
**MC NL PT SE**  
 Designated Extension States:  
**AL LT LV MK RO SI**

- **Repetto, Piermario**  
**10145 Torino (IT)**
- **Bigliati, Claudia**  
**13039 Trino (Vercelli) (IT)**
- **Lambertini, Vito**  
**10049 Giaveno (Torino) (IT)**
- **Sinesi, Sabino**  
**10045 Piosasco (IT)**

(30) Priority: **02.02.1999 IT TO990073**

(71) Applicant: **C.R.F. Società Consortile per Azioni**  
**10043 Orbassano (Torino) (IT)**

(72) Inventors:  
 • **Perlo, Piero**  
**12048 Sommariva Bosco (Cuneo) (IT)**

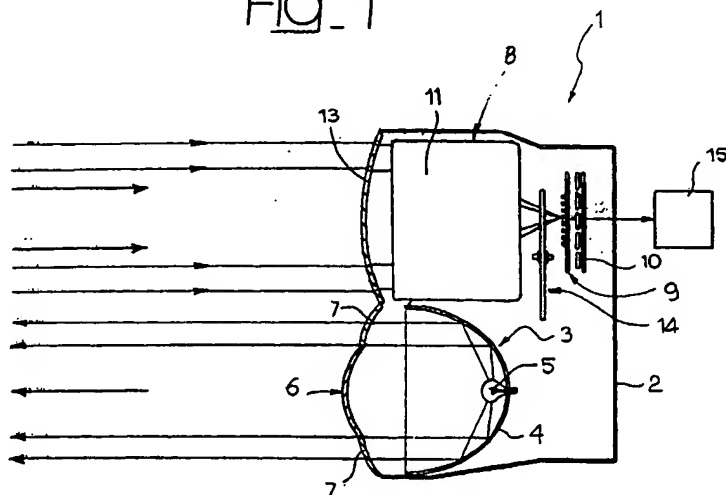
(74) Representative: **Notaro, Giancarlo et al**  
**c/o Buzzi, Notaro & Antonielli d'Oulx**  
**Via Maria Vittoria 18**  
**10123 Torino (IT)**

(54) **Dual-band infra-red vision system for motor-vehicles**

(57) An infrared vision system for motor vehicles comprises a device (8) for detecting infrared radiation, which is designed to detect both infrared radiation in a first wave band, which corresponds to the radiation spontaneously emitted by the objects making up the scene in front of the motor vehicle, and infrared radiation

in a second wave band, which is in part emitted spontaneously by the objects of the scene and in part is emitted by a source (5) of infrared radiation which forms part of the vision system (1) and is reflected by the objects in front of the vehicle towards the said detecting device (8).

**Fig. 1**





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number

EP 00 83 0062

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	FR 2 730 035 A (VALEO VISION) 2 August 1996 (1996-08-02) * the whole document *	1-7	B60Q1/20 B62D15/02 B60Q1/00
A	US 5 796 514 A (CHIPPER ROBERT B) 18 August 1998 (1998-08-18) * column 3, line 46 - column 4, line 16 * * column 9, line 56 - line 62 * * figures *	1-5,7	
A	DE 40 32 927 A (BOSCH GMBH ROBERT) 30 April 1992 (1992-04-30) * the whole document *	1,6,7	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B60Q B62D F21S H04N
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 19 November 2002	Examiner Sallard, F
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 83 0062

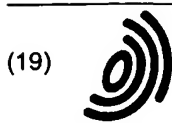
This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-11-2002

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2730035	A	02-08-1996	FR	2730035 A1	02-08-1996
-----					
US 5796514	A	18-08-1998	US	6151170 A	21-11-2000
			US	5852516 A	22-12-1998
			US	6249374 B1	19-06-2001
			US	6018414 A	25-01-2000
-----					
DE 4032927	A	30-04-1992	DE	4032927 A1	30-04-1992
-----					

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 1 026 031 A3**

(12)

## EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
22.01.2003 Bulletin 2003/04

(51) Int Cl.7: **B60Q 1/20**, B62D 15/02,  
B60Q 1/00

(43) Date of publication A2:  
09.08.2000 Bulletin 2000/32

(21) Application number: 00830062.6

(22) Date of filing: 28.01.2000

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

- Repetto, Piermario  
10145 Torino (IT)
- Bigliati, Claudia  
13039 Trino (Vercelli) (IT)
- Lambertini, Vito  
10049 Giaveno (Torino) (IT)
- Sinesi, Sabino  
10045 Piosasco (IT)

(30) Priority: 02.02.1999 IT TO990073

(71) Applicant: **C.R.F. Società Consortile per Azioni**  
10043 Orbassano (Torino) (IT)

(74) Representative: **Notaro, Giancarlo et al**  
**c/o Buzzi, Notaro & Antonielli d'Oulx**  
**Via Maria Vittoria 18**  
**10123 Torino (IT)**

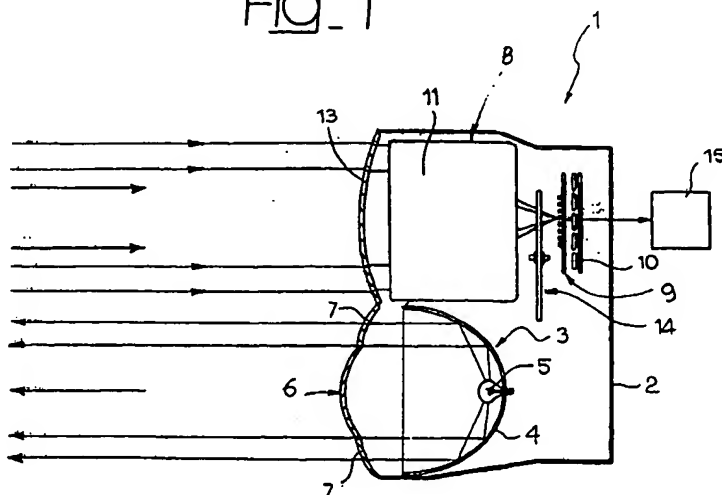
(72) Inventors:  
• Perlo, Piero  
12048 Sommariva Bosco (Cuneo) (IT)

### (54) Dual-band infra-red vision system for motor-vehicles

(57) An infrared vision system for motor vehicles comprises a device (8) for detecting infrared radiation, which is designed to detect both infrared radiation in a first wave band, which corresponds to the radiation spontaneously emitted by the objects making up the scene in front of the motor vehicle, and infrared radiation

in a second wave band, which is in part emitted spontaneously by the objects of the scene and in part is emitted by a source (5) of infrared radiation which forms part of the vision system (1) and is reflected by the objects in front of the vehicle towards the said detecting device (8).

Fig. 1



EP 1 026 031 A3



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 00 83 0062

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	FR 2 730 035 A (VALEO VISION) 2 August 1996 (1996-08-02) * the whole document *	1-7	B60Q1/20 B62D15/02 B60Q1/00
A	US 5 796 514 A (CHIPPER ROBERT B) 18 August 1998 (1998-08-18) * column 3, line 46 - column 4, line 16 * * column 9, line 56 - line 62 * * figures *	1-5,7	
A	DE 40 32 927 A (BOSCH GMBH ROBERT) 30 April 1992 (1992-04-30) * the whole document *	1,6,7	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)  B60Q B62D F21S H04N
Place of search <b>MUNICH</b>		Date of completion of the search <b>19 November 2002</b>	Examiner <b>Sallard, F</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.92 (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 83 0062

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-11-2002

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2730035	A	02-08-1996	FR	2730035 A1	02-08-1996
-----					
US 5796514	A	18-08-1998	US	6151170 A	21-11-2000
			US	5852516 A	22-12-1998
			US	6249374 B1	19-06-2001
			US	6018414 A	25-01-2000
-----					
DE 4032927	A	30-04-1992	DE	4032927 A1	30-04-1992
-----					

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**02.01.2004 Bulletin 2004/01**

(51) Int Cl.7: **B60Q 1/20, B62D 15/02,**  
**B60Q 1/00**

(21) Application number: **00830062.6**

(22) Date of filing: **28.01.2000**

(54) **Dual-band infra-red vision system for motor-vehicles**

Infrarotes Zweiband-Sichtsystem für Kraftfahrzeuge

Système de vision infrarouge à double bande pour véhicules automobiles

(84) Designated Contracting States:  
**DE ES FR GB IT SE**

(30) Priority: **02.02.1999 IT TO990073**

(43) Date of publication of application:  
**09.08.2000 Bulletin 2000/32**

(73) Proprietor: **C.R.F. Società Consortile per Azioni**  
**10043 Orbassano (Torino) (IT)**

(72) Inventors:  
• **Perlo, Piero**  
**12048 Sommariva Bosco (Cuneo) (IT)**  
• **Repetto, Piermario**  
**10145 Torino (IT)**

• **Bigliati, Claudia**  
**13039 Trino (Vercelli) (IT)**  
• **Lambertini, Vito**  
**10049 Giaveno (Torino) (IT)**  
• **Sinesi, Sabino**  
**10045 Piossasco (IT)**

(74) Representative: **Notaro, Giancarlo et al**  
**c/o Buzzi, Notaro & Antonielli d'Oulx**  
**Via Maria Vittoria 18**  
**10123 Torino (IT)**

(56) References cited:  
**DE-A- 4 032 927** **FR-A- 2 730 035**  
**US-A- 5 796 514**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

## Description

[0001] The present invention relates to infrared vision systems for motor vehicles, of the type comprising an infrared-radiation detecting device designed to be mounted on the front of a motor vehicle, the device including infrared sensor means designed to emit electrical signals according to the infrared radiation detected, optical imaging means for focusing the infrared image of the scene in front of the vehicle on said sensor means, electronic means for processing the signals issued by the sensor means, and image-displaying means controlled by said electronic means.

[0002] The known infrared vision systems that have so far been produced exploit infrared radiation in a wave band ranging from 8 to 14 micron (longwave window - LW), which is emitted spontaneously to a variable extent by all the objects of the scene in front of the motor vehicle. These systems do not enable optimal results to be achieved, especially in particular conditions, such as in the presence of fog.

[0003] An infrared vision system according to the preamble of claim 1 is known from FR-A-2 730 035.

[0004] The purpose of the present invention is to propose a new infrared vision system for motor vehicles that enables improvement of night vision in all conditions, and in particular in the presence of thick fog.

[0005] In order to achieve the above purpose, the subject of the invention is a vision system of the type specified above, characterized in that the aforesaid optical imaging means are designed to focus both infrared radiation in a first wave band, corresponding to the radiation spontaneously emitted by the objects of the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted spontaneously by the objects of the scene, and in part is emitted by a source of infrared radiation which forms part of the vision system and is reflected by the objects in front of the vehicle towards said detecting device.

[0006] As has already been mentioned, the radiation emitted spontaneously by the scene falls within a wavelength range of between 8 and 14 micron (longwave window - LW). In a preferred embodiment of the invention, the above-mentioned infrared-radiation source forming part of the system is designed to emit radiation in a wave band of between 3 and 5 micron (midwave window - MW). This radiation is reflected by the objects of the scene, and is then detected by the sensor means forming part of the system according to the invention. Again according to the invention, the aforesaid optical imaging means comprise two optical imaging devices, which are combined in such a way as to minimize dispersion between the two aforesaid wave bands, and a discriminator designed to send to the sensor means alternately the radiation in the first band and the radiation in the second band (for example, a discriminator of a rotary type).

[0007] In a preferred embodiment, the above-mentioned sensor means consist of a matrix of non-cooled

thermal sensors, of a type chosen from among pyro-electric sensors, resistive bolometers, ferro-electric bolometers, and thermo-electric sensors of a conventional type.

[0008] Again in the case of the preferred embodiment, the said infrared-radiation source consists of a headlight of the motor vehicle which has a front element that is at least in part transparent to infrared radiation. In this case, the detecting device of the vision system according to the invention is built into the said headlight of the motor vehicle.

[0009] The control electronics forming part of the system according to the invention makes it possible to read, interpret and superimpose the infrared images in the two bands acquired by the sensors, so presenting a single infrared image of the scene on the display means at output. The main advantage of the system according to the invention is that it enables simultaneous exploitation of the greater intensity of the IR image in the 8-14 micron LW window and the greater contrast of the IR image in the 3-4 micron MW window in the temperature range of interest.

[0010] Further characteristics and advantages of the invention will emerge from the ensuing description with reference to the attached drawings, which are provided purely as a non-limiting example and in which:

Figure 1 is a cross-sectional schematic view of a vision system according to the invention;

Figure 2 is a front view of a rotary discriminator forming part of the system of Figure 1; and

Figure 3 illustrates a variant of Figure 2.

[0011] In Figure 1, the reference number 1 designates, as a whole, a motor-vehicle headlight comprising a rigid casing 2 inside which is set a headlight 3 including a parabolic dish 4 associated to a lamp 5. The reference number 6 designates the transparent front element of the headlight 3, which presents, in the case of the example illustrated, peripheral windows 7 that are transparent to infrared radiation. The lamp 5 is chosen so as to emit infrared radiation in a wave band of between 3 and 5 micron.

[0012] The body 2 of the headlight 1 also includes an infrared-radiation detecting device 8 comprising infrared sensor means 9 consisting of a matrix of non-cooled thermal sensors, for example pyro-electric sensors or resistive bolometers, or ferro-electric bolometers, or thermoelectric sensors of a conventional type, which are designed to send electrical signals according to the infrared image detected to a processing electronic control unit 10. The detecting device 8 comprises an optical imaging system 11 which is designed to focus on the sensors 9 both the infrared image in the 3-5 micron wave band, which is reflected by the objects of the scene in front of the vehicle, and the infrared radiation in the 8-14 micron wave band, which is emitted spontaneously by the objects of the scene. The detecting device 8 has, at



the front, a window 13 which is transparent to infrared radiation.

[0013] Between the optical imaging system 11 and the matrix of sensors 9 is set a rotary optical discriminator 14, of which Figure 2 and 3 illustrate two possible embodiments. In both cases, the said optical discriminator 14 consists of a disc having sectors A that are transparent to infrared radiation of between 8 and 14 micron, sectors B that are transparent to infrared radiation of between 3 and 5 micron, and opaque sectors C that clearly divide the sectors A from the sectors B. The rotary discriminator 14 is used to send alternately the 8-14 micron infrared radiation and the 3-5 micron infrared radiation to the sensor means 9. The electronic control unit 10 is designed to read, interpret and superimpose the infrared images in the two bands acquired by the sensors, presenting at output, on a display 15 provided on the motor vehicle dashboard or on the windscreen itself, according to a HEAD-UP type technology, a single infrared image of the scene. As has already been mentioned, the main advantage of the device lies in the fact that it enables simultaneous exploitation of the greater intensity of the IR image in the 8-14 micron band and the greater contrast of the IR image in the 3-5 micron band.

[0014] The source of 3-5 micron IR radiation could also be a dedicated source, distinct from the vehicle headlight.

[0015] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to what is herein described and illustrated purely for the purpose of providing an example, without thereby departing from the scope of the present invention as defined by the appended claims.

#### Claims

1. An infrared vision system for motor vehicles, comprising a source (5) of infrared radiation and an infrared-radiation detecting device (8) designed to be mounted on the front of a motor vehicle, the device including infrared sensor means (9) designed to emit electrical signals according to the infrared radiation detected, optical imaging means (11) for focusing the infrared image of the scene in front of the vehicle on said sensor means (9), electronic means (10) for processing the signals issued by the sensor means (9), and image-displaying means (15) controlled by said electronic means (10),

characterized in that said optical imaging means (11) are designed to focus both infrared radiation in a first wave band, corresponding to the radiation spontaneously emitted by the objects of the scene in front of the motor vehicle, and infrared radiation in a second wave band, which is in part emitted spontaneously by the objects of the scene, and in part is emitted by the source (5) of infrared

radiation which forms part of said vision system (1) and is reflected by the objects in front of the vehicle towards said detecting device (8).

2. A vision system according to Claim 1, characterized in that the optical imaging means (11) comprise two optical imaging devices, which are combined in such a way as to minimize dispersion between the two aforesaid wave bands, and a rotary discriminator (14) designed to send to the sensor means (9) alternately the radiation in the first band and the radiation in the second band.
3. A vision system according to Claim 2, characterized in that the sensor means (9) consist of a matrix of non-cooled thermal sensors, of a type chosen from among pyro-electric sensors, resistive bolometers, ferro-electric bolometers, and thermo-electric sensors of a conventional type.
4. A vision system according to Claim 1, characterized in that said first band includes wavelengths ranging from 8 to 14 micron.
5. A vision system according to Claim 1, characterized in that said second band includes wavelengths ranging from 3 to 5 micron.
6. A vision system according to Claim 1, characterized in that said infrared-radiation source (5) consists of a headlight (3) of the motor vehicle, which has a front element (6), at least part (7) of which is transparent to said infrared radiation.
7. A vision system according to Claim 1, characterized in that the control electronics forming part of the system according to the invention makes it possible to read, interpret and superimpose the infrared images in the two bands acquired by the sensors, so presenting a single infrared image of the scene on the display means at output.

#### Patentansprüche

1. Infrarotsichtsystem für Kraftfahrzeuge, aufweisend eine Quelle (5) für Infrarotstrahlung und eine Infrarotstrahlungsdetektionsvorrichtung (8), gestaltet, um an der Front eines Kraftfahrzeugs angebracht zu sein, wobei die Vorrichtung Infrarotsensormittel (9) einschließt, die gestaltet sind, um elektrische Signale entsprechend der detektierten Infrarotstrahlung auszusenden, optische Bildmittel (11), zum Fokussieren des Infrarotbildes der Szene vor dem Fahrzeug auf die Sensormittel (9), elektronische Mittel (10), zum Verarbeiten der Signale, welche von den Sensormitteln (9) ausgegeben sind, und Bildanzeigemittel (15), gesteuert durch die elektro-

nischen Mittel (10),

**dadurch gekennzeichnet, dass** die optischen Bildmittel (11) gestaltet sind, um sowohl Infrarotstrahlung in einem ersten Wellenband, entsprechend der spontan emittierten Strahlung durch die Objekte der Szene vor dem Kraftfahrzeug, und Infrarotstrahlung in einem zweiten Wellenband zu fokussieren, welches teilweise spontan durch die Objekte der Szene emittiert ist und teilweise durch die Quelle (5) für Infrarotstrahlung emittiert ist, welche einen Teil des Sichtsystems (1) bildet, und durch die Objekte vor dem Fahrzeug zu der Detektionsvorrichtung (8) reflektiert ist.

2. Sichtsystem gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die optischen Bildmittel (11) zwei optische Bildvorrichtungen umfassen, welche in einer solchen Art und Weise kombiniert sind, um eine Dispersion zwischen den zwei vorgenannten Wellenbändern zu minimieren, und einen Drehdiskriminator (14), gestaltet, um wechselweise die Strahlung in dem ersten Band und die Strahlung in dem zweiten Band zu den Sensormitteln (9) zu senden.
3. Sichtsystem gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die Sensormittel (9) aus einer Matrix aus nicht gekühlten thermischen Sensoren bestehen, von einem Typ ausgewählt aus pyroelektrischen Sensoren, Widerstandsbolometern, ferroelektrischen Bolometern und thermoelektrischen Sensoren eines herkömmlichen Typs.
4. Sichtsystem gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das erste Band Wellenlängen einschließt, welche von 8 bis 14  $\mu\text{m}$  reichen.
5. Sichtsystem gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das zweite Band Wellenlängen einschließt, welche von 3 bis 5  $\mu\text{m}$  reichen.
6. Sichtsystem gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Infrarotstrahlungsquelle (5) aus einem Frontscheinwerfer (3) des Kraftfahrzeugs besteht, welches ein Frontelement (6) aufweist, zumindest dessen Teil (7) für die Infrarotstrahlung transparent ist.
7. Sichtsystem gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Steuerelektronik, welche einen Teil des Systems gemäß der Erfindung bildet, es möglich macht, die Infrarotbilder in den zwei Bändern, erhalten durch die Sensoren, zu lesen, zu interpretieren und zu überlagern, um so ein einzelnes Infrarotbild der Szene auf den Anzeigemitteln einer Ausgabe darzubieten.

## Revendications

1. Système de vision infrarouge pour véhicules automobiles, comportant une source (5) de rayonnement infrarouge et un dispositif (8) de détection de rayonnement infrarouge conçu pour être monté sur l'avant d'un véhicule automobile, le dispositif comprenant des moyens formant capteurs à infrarouge (9) conçus pour émettre des signaux électriques conformément au rayonnement infrarouge détecté, des moyens d'imagerie optique (11) pour focaliser l'image infrarouge de la scène en avant du véhicule sur lesdits moyens formant capteurs (9), des moyens électronique (10) pour traiter des signaux délivrés par les moyens formant capteurs (9), et des moyens d'affichage d'images (15) commandés par lesdits moyens électroniques (10),  
**caractérisé en ce que** lesdits moyens d'imagerie optique (11) sont conçus de manière à focaliser à la fois le rayonnement infrarouge dans une première bande d'ondes correspondant au rayonnement émis spontanément par les objets de la scène en avant du véhicule automobile, et un rayonnement infrarouge dans une seconde bande d'ondes et qui en partie est émise spontanément par les images de la scène, et en partie est émise par la source (5) de rayonnement infrarouge, qui fait partie dudit système de vision (1) et est réfléchi par les objets en avant du véhicule en direction du dispositif de détection (8).
2. Système de vision selon la revendication 1, **caractérisé en ce que** les moyens d'imagerie optique (11) comprennent deux dispositifs d'imagerie optique, qui sont combinés de manière à minimiser la dispersion entre les deux bandes d'ondes mentionnées précédemment, et un discriminateur rotatif (14) conçu de manière à envoyer aux moyens formant capteurs (9) alternativement le rayonnement dans la première bande et le rayonnement dans la seconde bande.
3. Système de vision selon la revendication 2, **caractérisé en ce que** les moyens formant capteurs (9) sont constitués par une matrice de capteurs thermiques non refroidis, d'un type choisi parmi des capteurs pyroélectriques, des bolomètres résistifs, des bolomètres ferroélectriques et des capteurs thermoelectriques d'un type classique.
4. Système de vision selon la revendication 1, **caractérisé en ce que** ladite première bande inclut des longueurs d'onde s'étageant entre 8 et 14 micromètres.
5. Système de vision selon la revendication 1, **caractérisé en ce que** ladite seconde bande inclut des longueurs d'onde s'étageant entre 3 et 5 micromètres.

tres.

6. Système de vision selon la revendication 1, **carac-**  
**térisé en ce que** ladite source de rayonnement in- 5  
frarouge (5) est constituée par un phare (3) du vé-  
hicule automobile, qui possède un élément avant  
(6), dont au moins une partie (7) est transparente  
pour ledit rayonnement infrarouge.
7. Système de vision selon la revendication 1, **carac-** 10  
**térisé en ce que** le système électronique de com-  
mande, qui fait partie du système selon l'invention,  
permet de lire, d'interpréter et de superposer les  
images infrarouges dans les deux bandes qui sont 15  
reçues par les capteurs, en présentant ainsi une  
seule image infrarouge de la scène sur les moyens  
d'affichage, en tant que signal de sortie.

20

25

30

35

40

45

50

55



Fig. 2

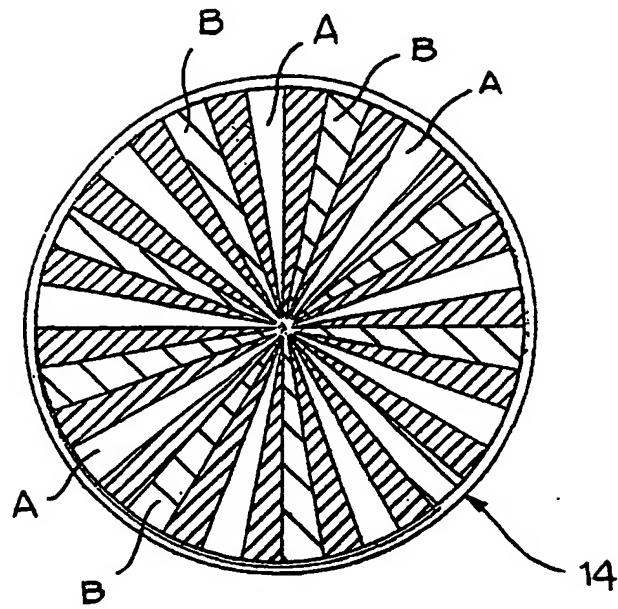


Fig. 3

